FIG. 1

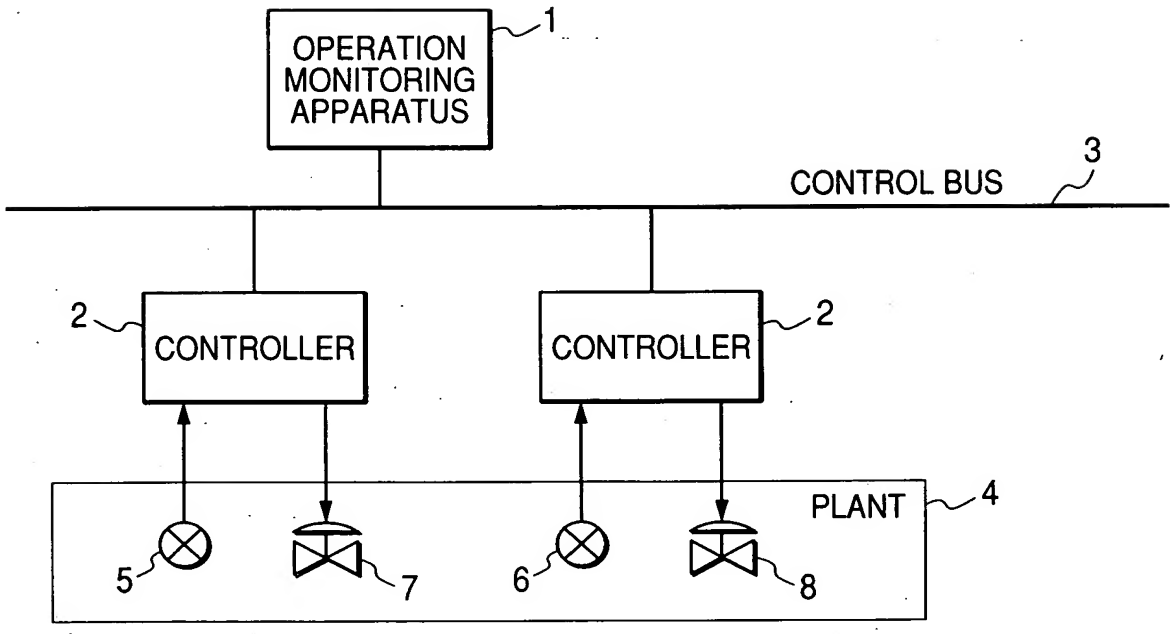

OPERATION MONITORING APPARATUS
1
CONTROL BUS
3
2
CONTROLLER
2
CONTROLLER
PLANT
4
5
7
6
8

FIG. 2

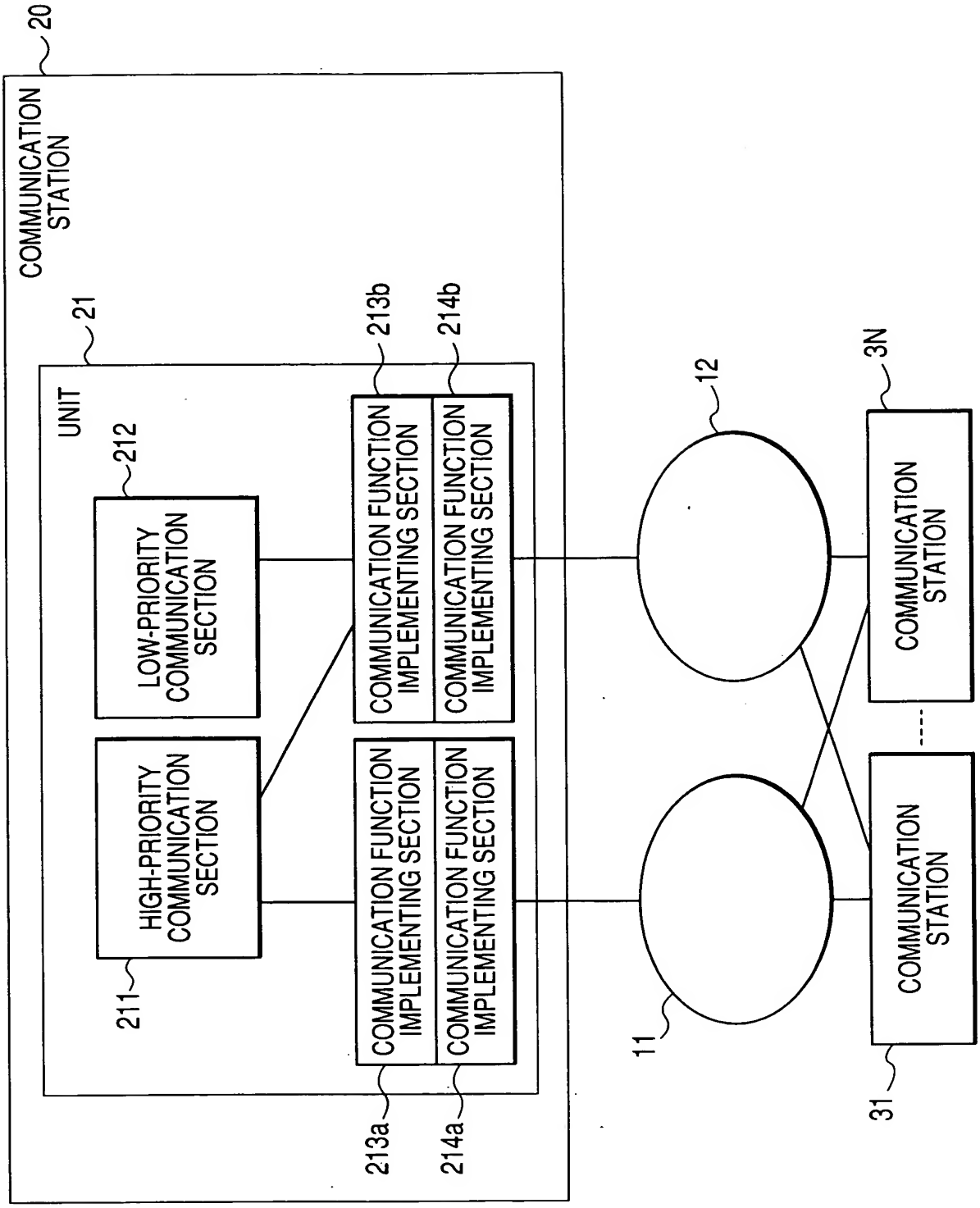

20
COMMUNICATION STATION
21
UNIT
212
LOW-PRIORITY COMMUNICATION SECTION
211
HIGH-PRIORITY COMMUNICATION SECTION
213b
214b
COMMUNICATION FUNCTION IMPLEMENTING SECTION
COMMUNICATION FUNCTION IMPLEMENTING SECTION
213a
214a
COMMUNICATION FUNCTION IMPLEMENTING SECTION
COMMUNICATION FUNCTION IMPLEMENTING SECTION
12
11
3N
COMMUNICATION STATION
COMMUNICATION STATION
31

FIG. 3

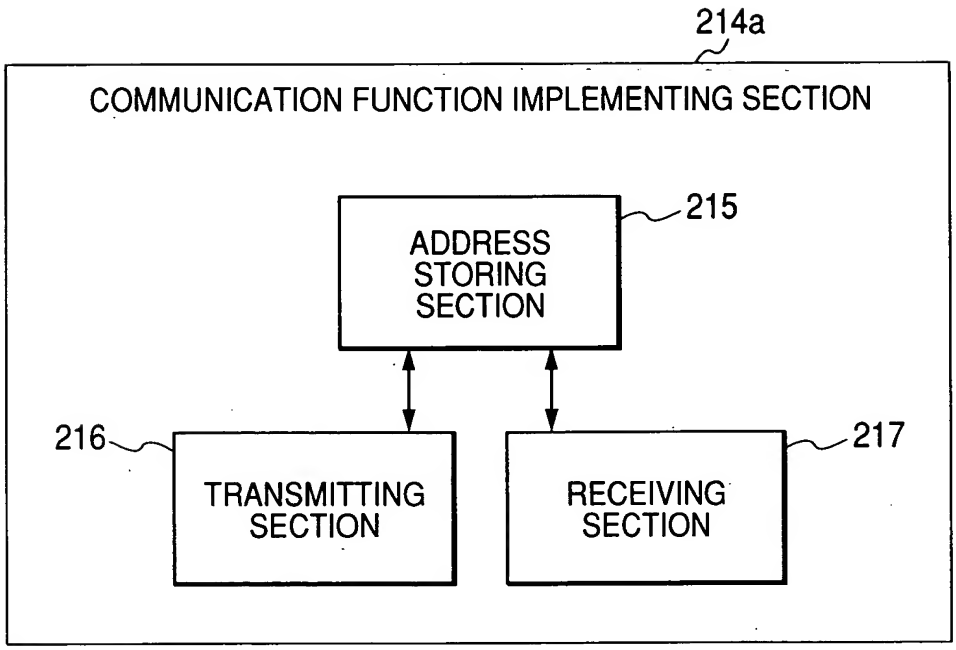

214a
COMMUNICATION FUNCTION IMPLEMENTING SECTION
ADDRESS STORING SECTION
215
216
TRANSMITTING SECTION
RECEIVING SECTION
217

FIG. 4

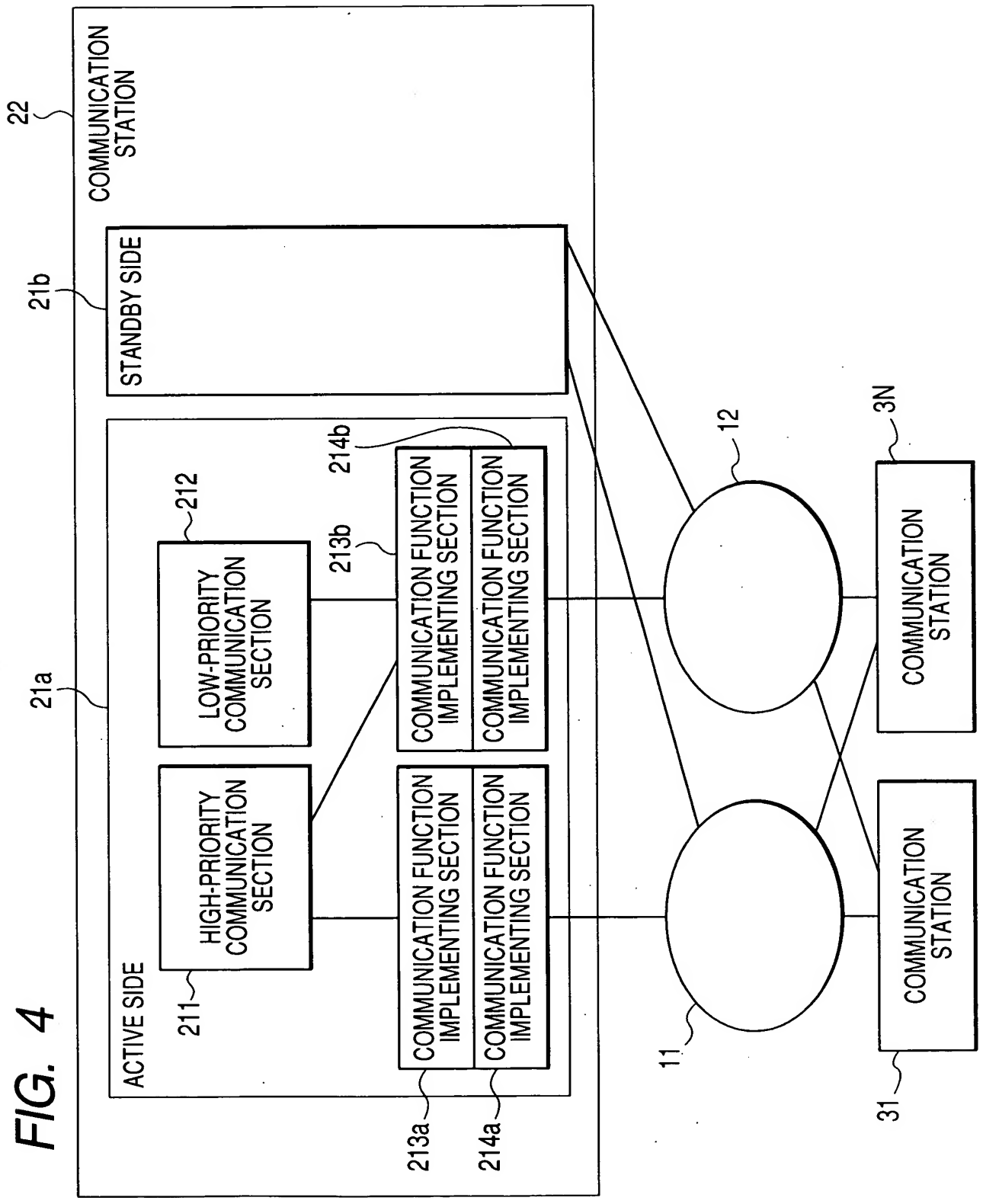

22
COMMUNICATION STATION
21b
STANDBY SIDE
21a
ACTIVE SIDE
211
HIGH-PRIORITY COMMUNICATION SECTION
212
LOW-PRIORITY COMMUNICATION SECTION
213a
COMMUNICATION FUNCTION IMPLEMENTING SECTION
214a
COMMUNICATION FUNCTION IMPLEMENTING SECTION
213b
COMMUNICATION FUNCTION IMPLEMENTING SECTION
214b
COMMUNICATION FUNCTION IMPLEMENTING SECTION
11
12
31
COMMUNICATION STATION
3N
COMMUNICATION STATION

FIG. 5

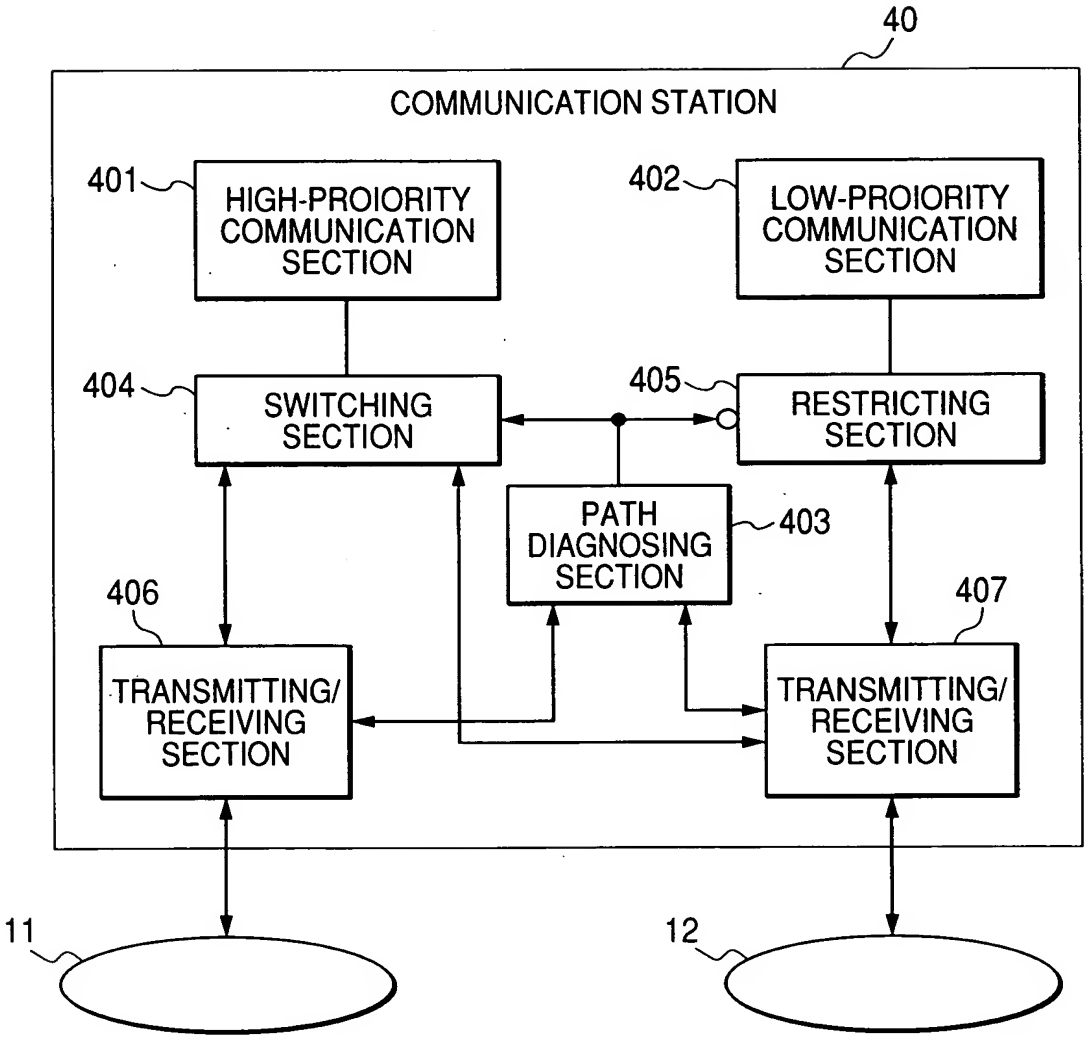

40
COMMUNICATION STATION
401
HIGH-PROIORITY COMMUNICATION SECTION
402
LOW-PROIORITY COMMUNICATION SECTION
404
SWITCHING SECTION
405
RESTRICTING SECTION
PATH DIAGNOSING SECTION
403
406
407
TRANSMITTING/ RECEIVING SECTION
TRANSMITTING/ RECEIVING SECTION
11
12

FIG. 6

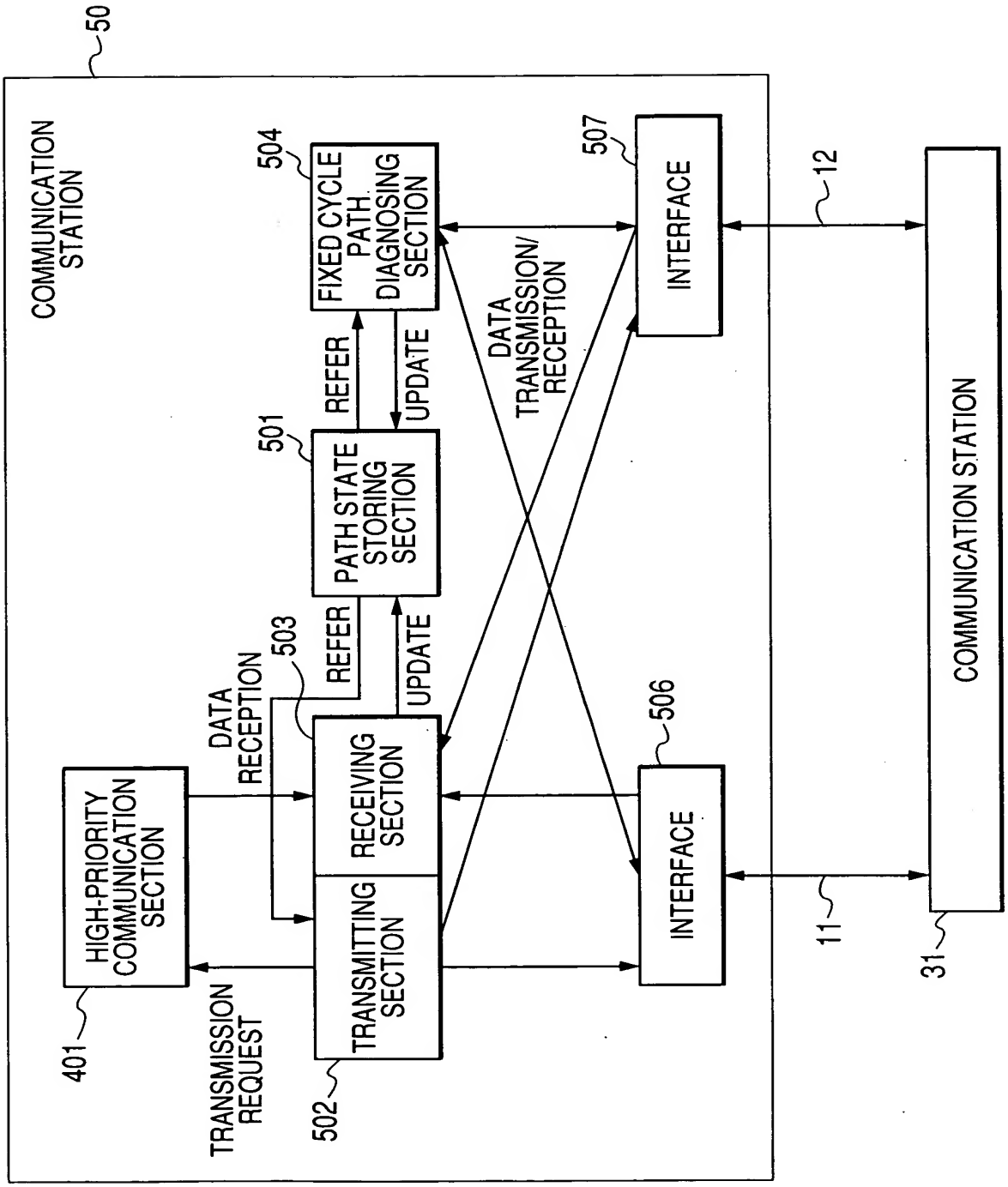

50
COMMUNICATION STATION
504
FIXED CYCLE PATH DIAGNOSING SECTION
507
INTERFACE
12
REFER
UPDATE
501
PATH STATE STORING SECTION
DATA TRANSMISSION/ RECEPTION
DATA RECEPTION
503
REFER
UPDATE
RECEIVING SECTION
506
HIGH-PRIORITY COMMUNICATION SECTION
401
TRANSMISSION REQUEST
TRANSMITTING SECTION
502
INTERFACE
11
31
COMMUNICATION STATION

FIG. 7

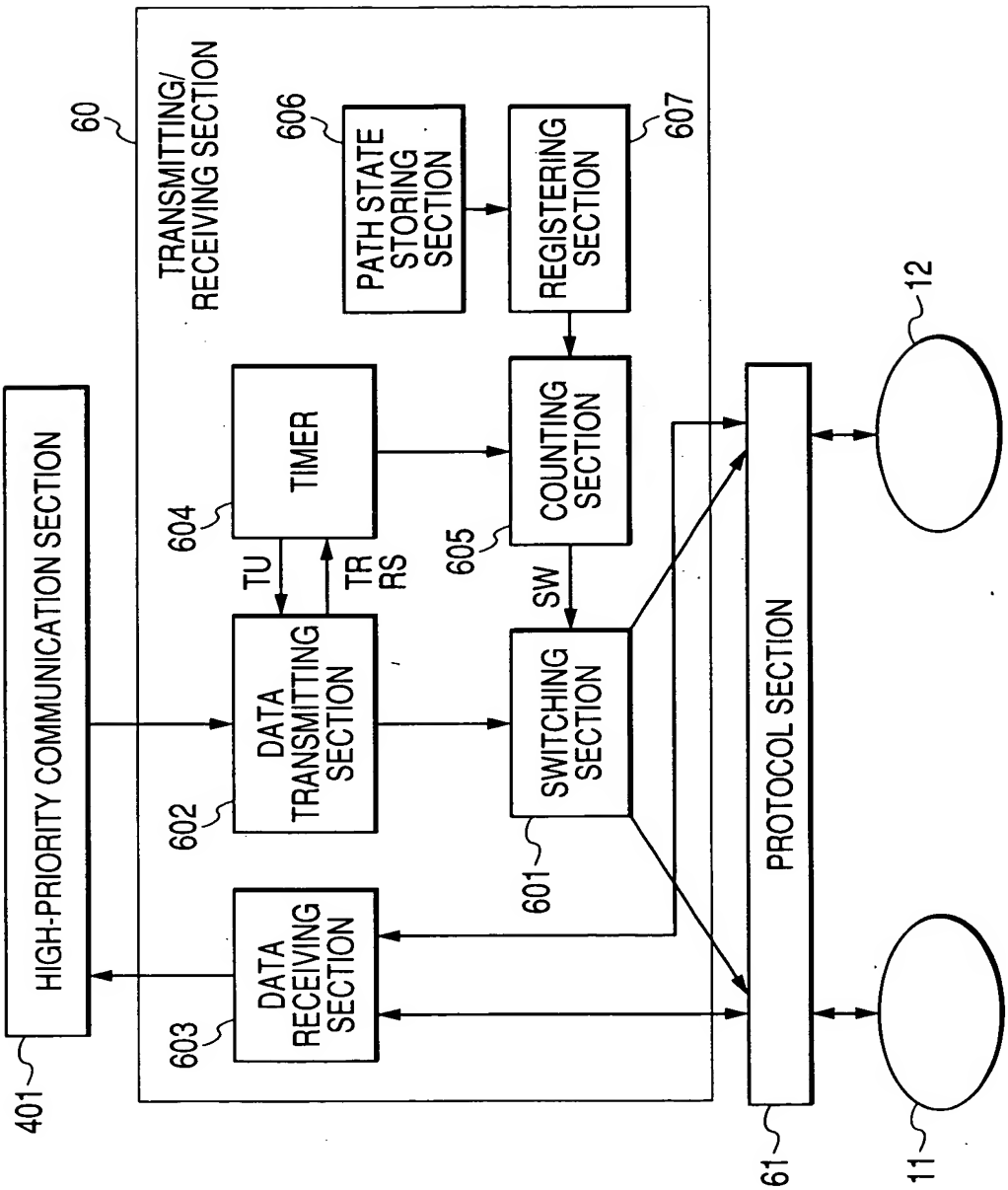

60
TRANSMITTING/
RECEIVING SECTION
606
PATH STATE
STORING
SECTION
607
REGISTERING
SECTION
12
HIGH-PRIORITY COMMUNICATION SECTION
604
TIMER
TU
TR
RS
605
COUNTING
SECTION
SW
602
DATA
TRANSMITTING
SECTION
601
SWITCHING
SECTION
603
DATA
RECEIVING
SECTION
PROTOCOL SECTION
401
61
11

FIG. 8

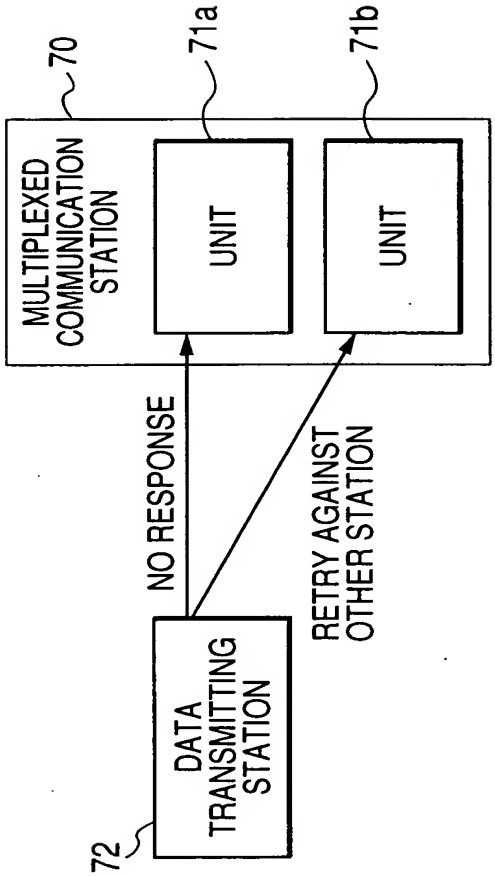

MULTIPLEXED COMMUNICATION STATION
70
UNIT
71a
UNIT
71b
NO RESPONSE
RETRY AGAINST OTHER STATION
DATA TRANSMITTING STATION
72

FIG. 9

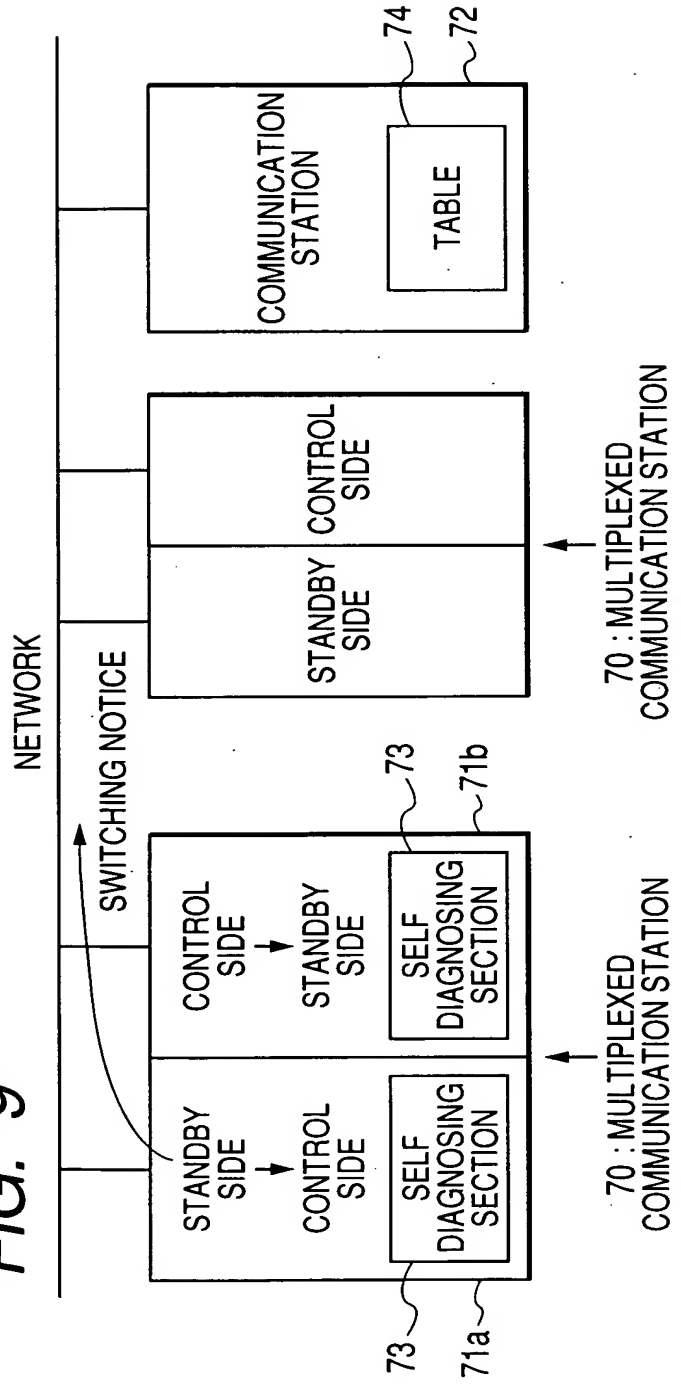

NETWORK
SWITCHING NOTICE
STANDBY SIDE → CONTROL SIDE
SELF DIAGNOSING SECTION
CONTROL SIDE → STANDBY SIDE
SELF DIAGNOSING SECTION
73
71b
73
71a
70 : MULTIPLEXED COMMUNICATION STATION
STANDBY SIDE
CONTROL SIDE
70 : MULTIPLEXED COMMUNICATION STATION
COMMUNICATION STATION
TABLE
74
72

FIG. 10

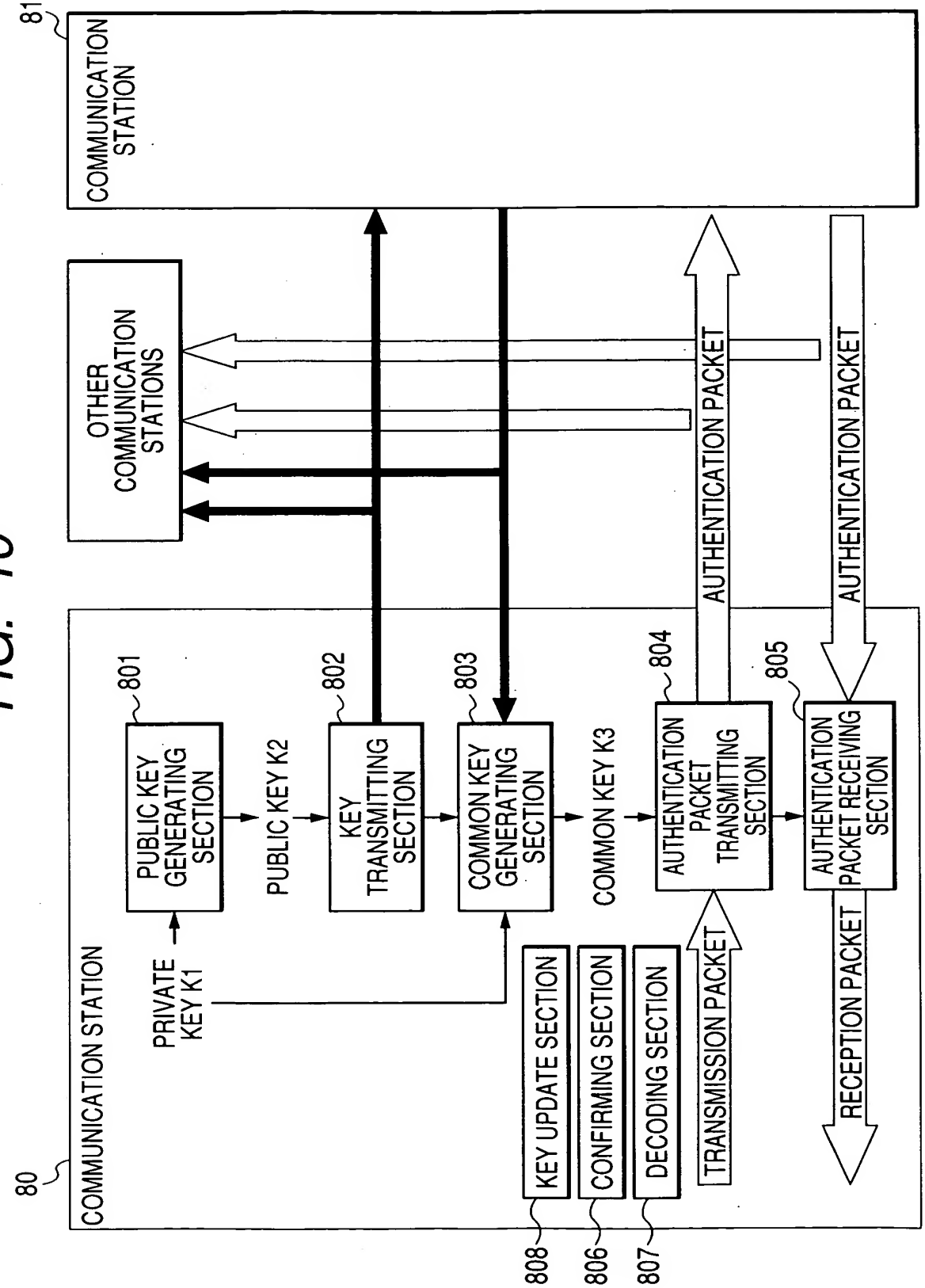

81
COMMUNICATION STATION
OTHER COMMUNICATION STATIONS
AUTHENTICATION PACKET
AUTHENTICATION PACKET
80
COMMUNICATION STATION
801
PUBLIC KEY GENERATING SECTION
PUBLIC KEY K2
802
KEY TRANSMITTING SECTION
803
COMMON KEY GENERATING SECTION
COMMON KEY K3
804
AUTHENTICATION PACKET TRANSMITTING SECTION
805
AUTHENTICATION PACKET RECEIVING SECTION
PRIVATE KEY K1
KEY UPDATE SECTION
CONFIRMING SECTION
DECODING SECTION
TRANSMISSION PACKET
RECEPTION PACKET
808
806
807

FIG. 11

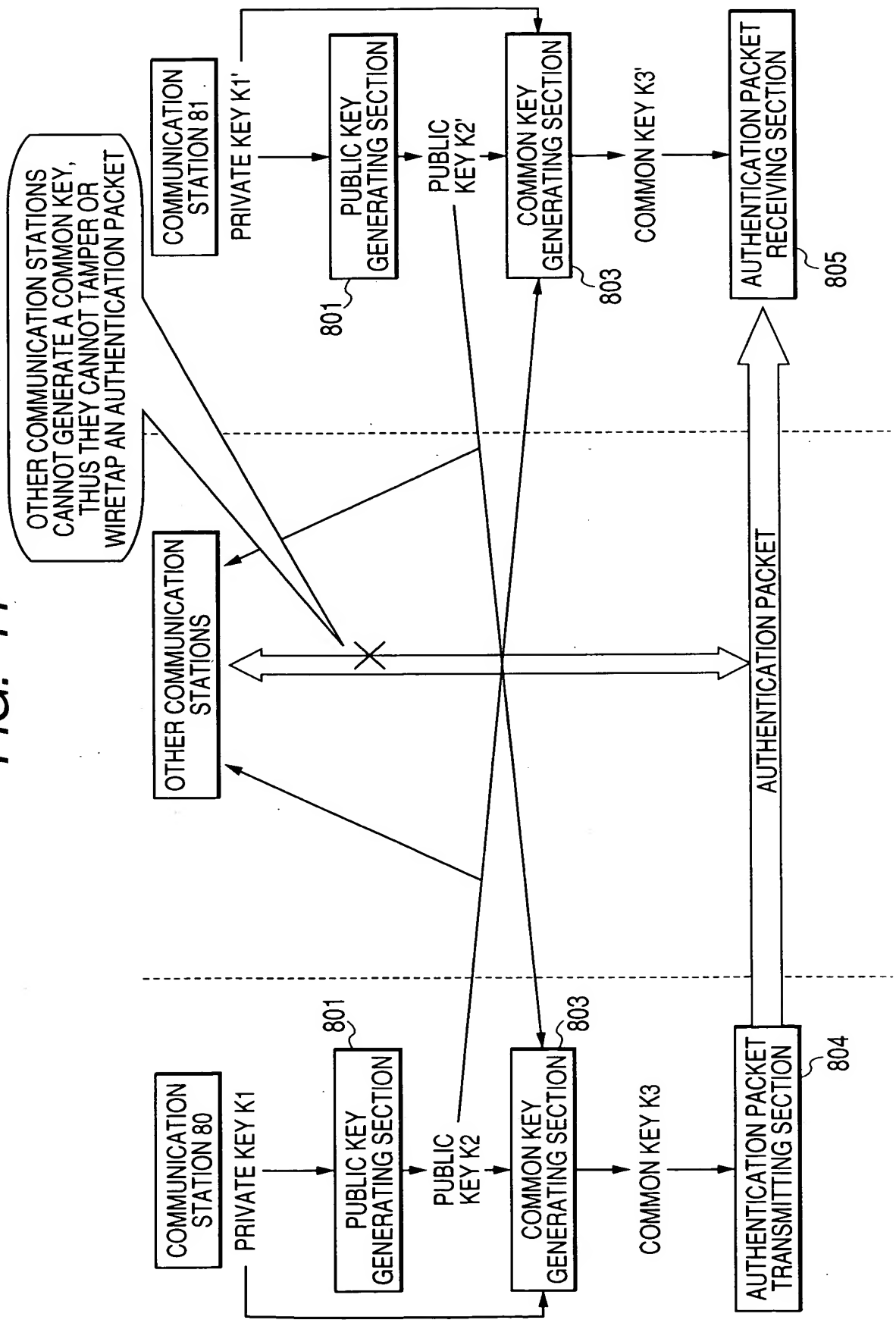

COMMUNICATION STATION 80
PRIVATE KEY K1
801
PUBLIC KEY GENERATING SECTION
PUBLIC KEY K2
803
COMMON KEY GENERATING SECTION
COMMON KEY K3
AUTHENTICATION PACKET TRANSMITTING SECTION
804
AUTHENTICATION PACKET
AUTHENTICATION PACKET RECEIVING SECTION
805
COMMON KEY K3'
COMMON KEY GENERATING SECTION
803
PUBLIC KEY K2'
PUBLIC KEY GENERATING SECTION
801
PRIVATE KEY K1'
COMMUNICATION STATION 81
OTHER COMMUNICATION STATIONS
OTHER COMMUNICATION STATIONS CANNOT GENERATE A COMMON KEY, THUS THEY CANNOT TAMPER OR WIRETAP AN AUTHENTICATION PACKET

FIG. 12

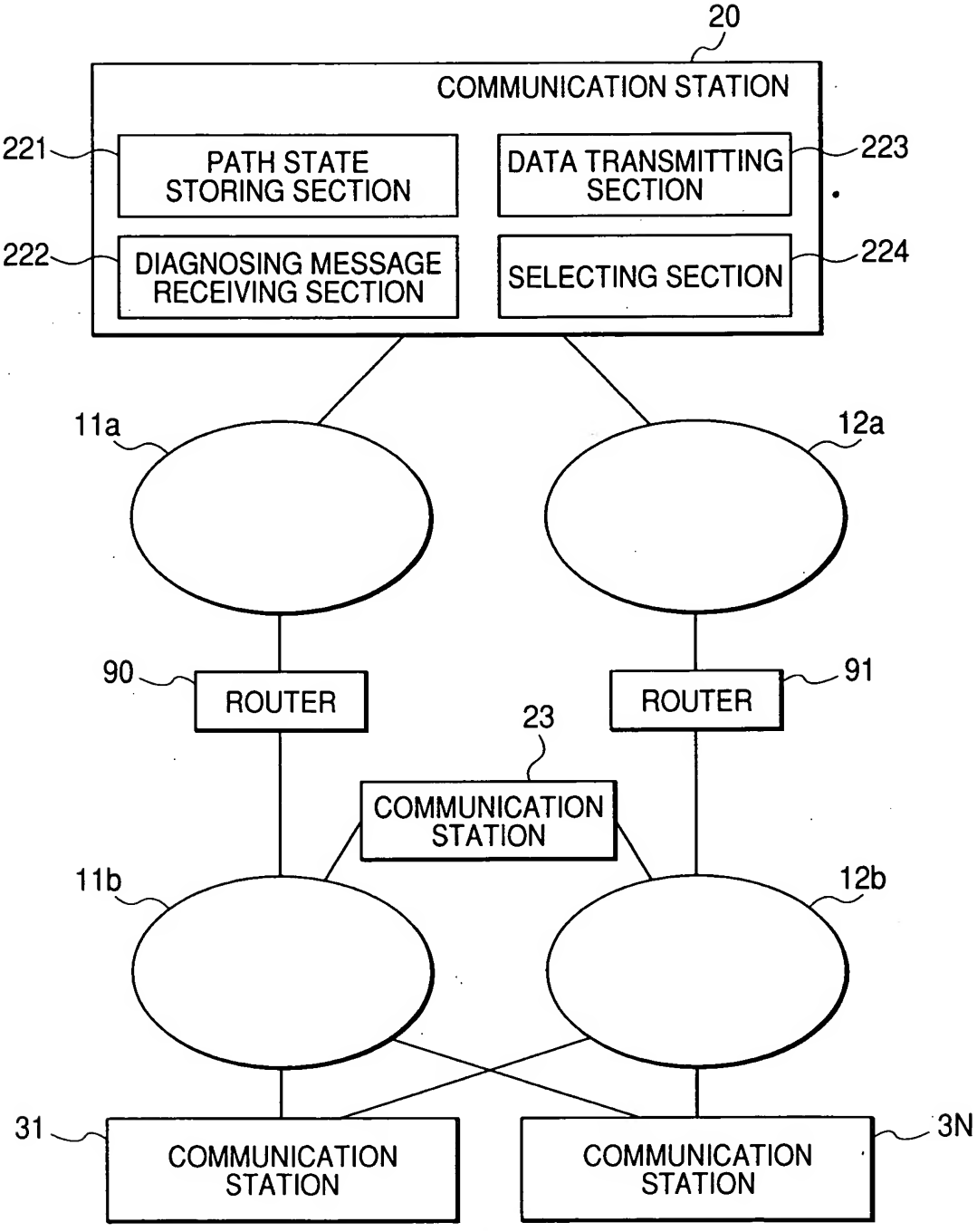

20
COMMUNICATION STATION
221
PATH STATE STORING SECTION
223
DATA TRANSMITTING SECTION
222
DIAGNOSING MESSAGE RECEIVING SECTION
224
SELECTING SECTION
11a
12a
90
ROUTER
91
ROUTER
23
COMMUNICATION STATION
11b
12b
31
COMMUNICATION STATION
COMMUNICATION STATION
3N

FIG. 13

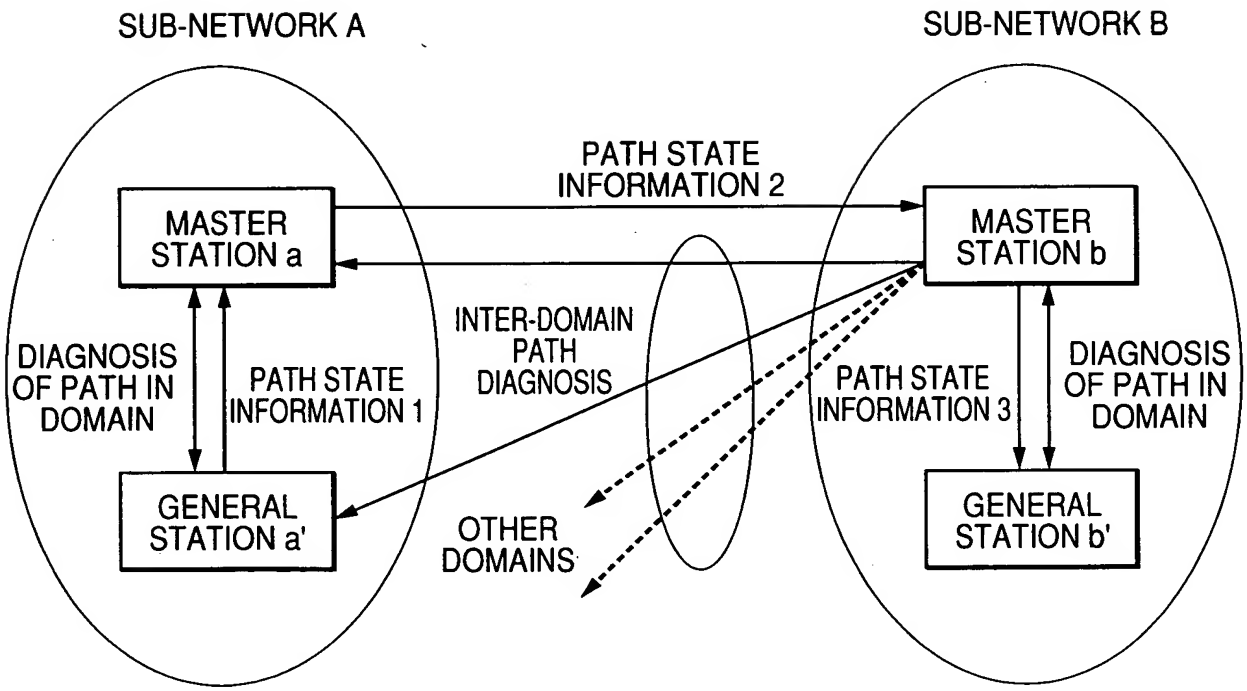

SUB-NETWORK A
SUB-NETWORK B
PATH STATE INFORMATION 2
MASTER STATION a
MASTER STATION b
DIAGNOSIS OF PATH IN DOMAIN
PATH STATE INFORMATION 1
INTER-DOMAIN PATH DIAGNOSIS
PATH STATE INFORMATION 3
DIAGNOSIS OF PATH IN DOMAIN
GENERAL STATION a'
GENERAL STATION b'
OTHER DOMAINS

FIG. 14

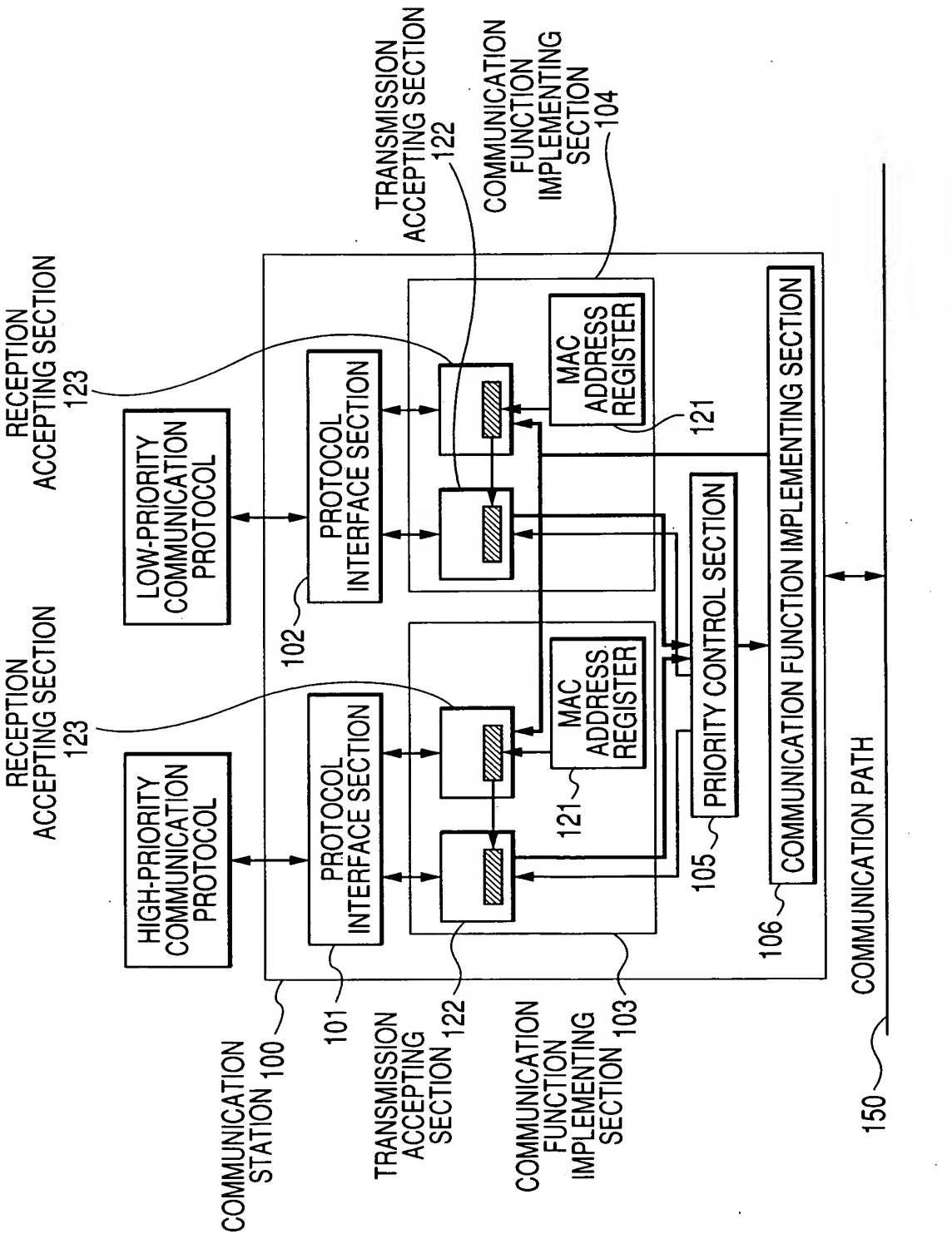

COMMUNICATION STATION 100
TRANSMISSION ACCEPTING SECTION 122
COMMUNICATION FUNCTION IMPLEMENTING SECTION 103
101
HIGH-PRIORITY COMMUNICATION PROTOCOL
LOW-PRIORITY COMMUNICATION PROTOCOL
RECEPTION ACCEPTING SECTION 123
RECEPTION ACCEPTING SECTION 123
PROTOCOL INTERFACE SECTION
PROTOCOL INTERFACE SECTION
102
121
MAC ADDRESS REGISTER
MAC ADDRESS REGISTER
121
PRIORITY CONTROL SECTION
105
106
COMMUNICATION FUNCTION IMPLEMENTING SECTION
TRANSMISSION ACCEPTING SECTION 122
COMMUNICATION FUNCTION IMPLEMENTING SECTION 104
COMMUNICATION PATH
150

FIG. 15

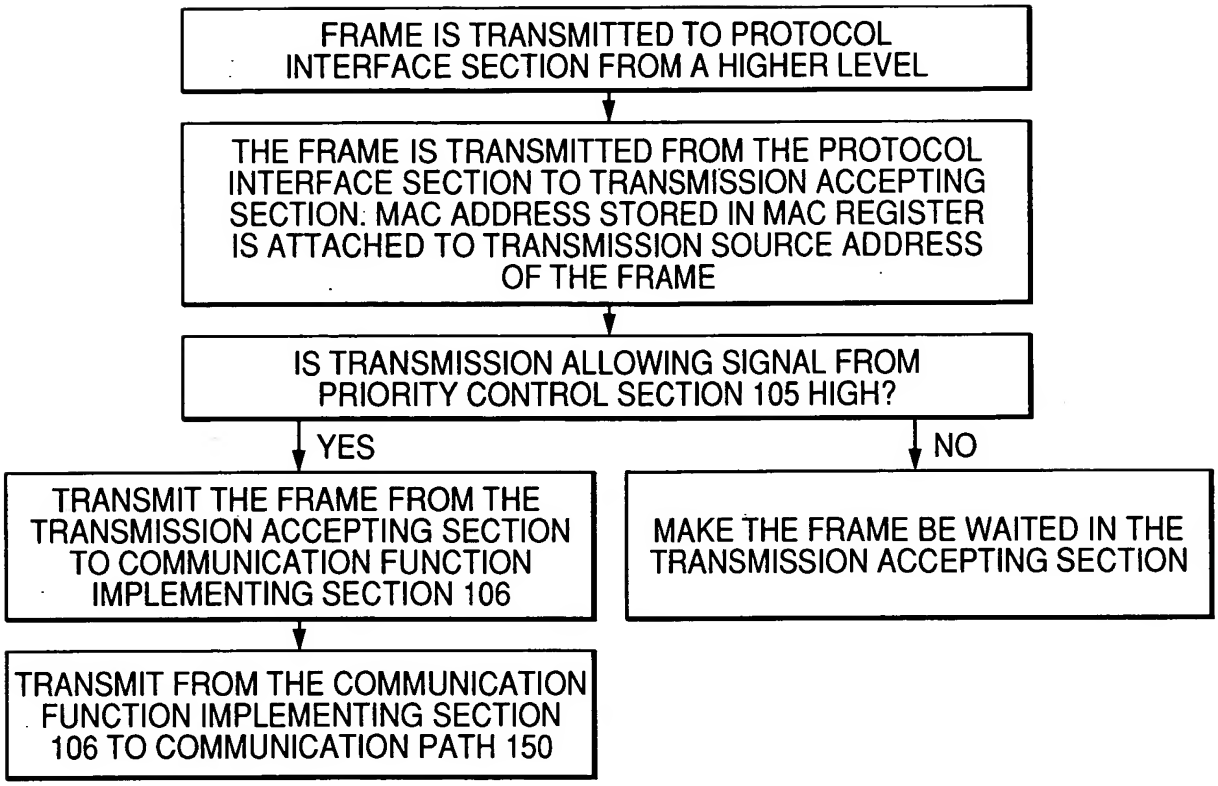
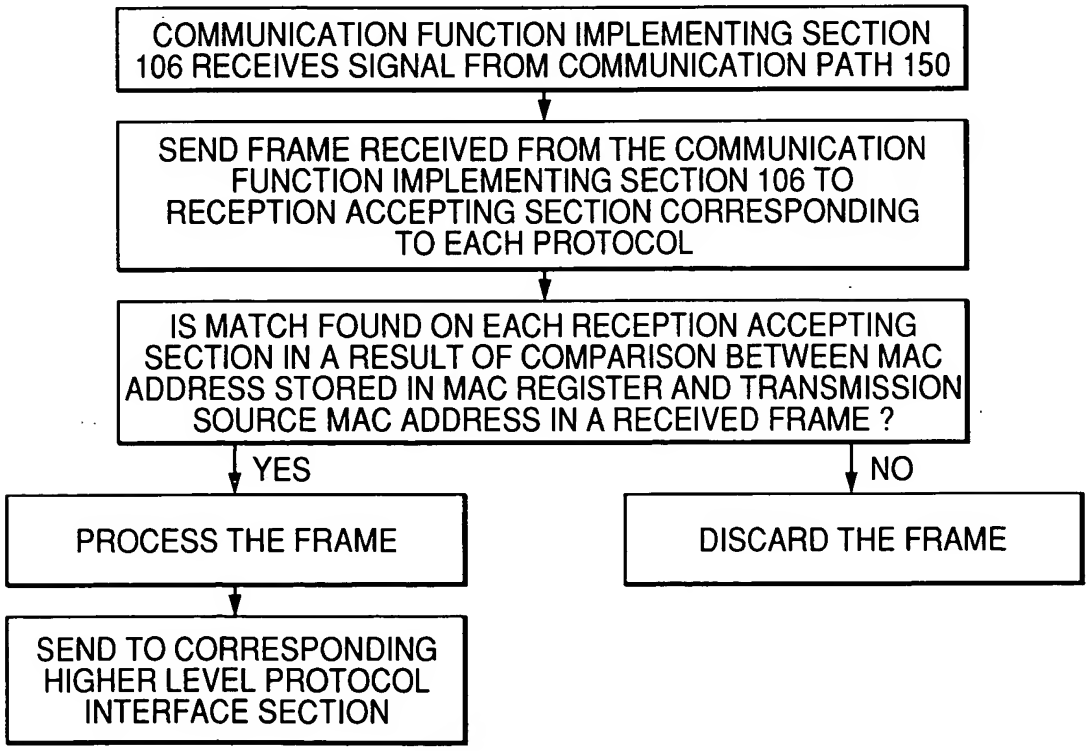

FRAME IS TRANSMITTED TO PROTOCOL INTERFACE SECTION FROM A HIGHER LEVEL
THE FRAME IS TRANSMITTED FROM THE PROTOCOL INTERFACE SECTION TO TRANSMISSION ACCEPTING SECTION. MAC ADDRESS STORED IN MAC REGISTER IS ATTACHED TO TRANSMISSION SOURCE ADDRESS OF THE FRAME
IS TRANSMISSION ALLOWING SIGNAL FROM PRIORITY CONTROL SECTION 105 HIGH?
YES
NO
TRANSMIT THE FRAME FROM THE TRANSMISSION ACCEPTING SECTION TO COMMUNICATION FUNCTION IMPLEMENTING SECTION 106
MAKE THE FRAME BE WAITED IN THE TRANSMISSION ACCEPTING SECTION
TRANSMIT FROM THE COMMUNICATION FUNCTION IMPLEMENTING SECTION 106 TO COMMUNICATION PATH 150

FIG. 16


COMMUNICATION FUNCTION IMPLEMENTING SECTION 106 RECEIVES SIGNAL FROM COMMUNICATION PATH 150
SEND FRAME RECEIVED FROM THE COMMUNICATION FUNCTION IMPLEMENTING SECTION 106 TO RECEPTION ACCEPTING SECTION CORRESPONDING TO EACH PROTOCOL
IS MATCH FOUND ON EACH RECEPTION ACCEPTING SECTION IN A RESULT OF COMPARISON BETWEEN MAC ADDRESS STORED IN MAC REGISTER AND TRANSMISSION SOURCE MAC ADDRESS IN A RECEIVED FRAME ?
YES
NO
PROCESS THE FRAME
DISCARD THE FRAME
SEND TO CORRESPONDING HIGHER LEVEL PROTOCOL INTERFACE SECTION